Geographic Coordinate Data Base

GCDB Reliability Diagram

Description Document

November 2001

United States Department of the Interior
Bureau of Land Management
Land & Resources Project Office
Denver Federal Center
Denver, Colorado 80225-0047

General Description

The Geographic Coordinate Data Base (GCDB) is a representation of the Public Land Survey System (PLSS) of the United States. The coordinate values that comprise the GCDB are based on the bearings and distances of the official survey records. A detailed description of GCDB - and it's source documents, intended use, and data elements - is available in the GCDB National Metadata which is posted at http://lm0500.blm.gov/gcdbmap.html.

The GCDB data collection software includes tools to help the GCDB Specialist determine the geometry of PLSS parcels in relation to the coordinate values of known locations for control points within the PLSS grid. The positions of the coordinates that were collected using the Geographic Measurement Management (GMM) software were adjusted using both compass rule and a least squares analysis. Each GMM coordinate is assigned a reliability factor indicating the error ellipse in feet in both northing and easting. (Error Ellipse North and Error Ellipse East)

Coordinates collected using the PCCS (Public Land Survey System Coordinate Computation System) software were adjusted using a succession of compass rule adjustments between the control points, followed by a least squares analysis. Each PCCS coordinate carries positional reliability factors (in feet) for the average of the misclosures in the data set and the maximum misclosure in the data set. (Average Reliability and Maximum Reliability)

The positions of some GCDB coordinates are very reliable because they are based on recent land surveys that were performed by credible surveyors. Additionally, the most reliable points are located in areas where geographic positions of horizontal control monuments have been established. Other coordinates are not as reliable because these conditions do not exist.

The reliability values for GMM and PCCS share common fields called Error_N and Error_E which are located in positions 42 - 55 of each record in the township.LX file. The same reliability values are stored in the Node Attribute table, Reliability Arc Attribute table, and the Reliability Areas Polygon Attribute table in the GCDB GIS coverages.

The reliability diagrams are composed of two GIS layers (coverages), Reliability Lines and Reliability Areas. The GIS coverages utilize the Universal Transverse Mercator (UTM) coordinate projection. A complete description of the GCDB coverages is available in the November 2001 GCDB Coverage Format Description Document which is posted at http://www-a.blm.gov/gcdb/Standards/index.html.

The reliability diagrams can be easily displayed in ArcEdit using the ArcInfo Interface (AIX module) of GCDB Data Prep v.1.04-11162001. ArcView, and other GIS tools, may also be used to display the diagrams; however, user interaction is required to bring in the coverage, set the colors, make the legend, add themes, and customize the display. This capability could be provided in GCDB ArcView Tools (Windows/NT software) in the coming months if the software changes are authorized.
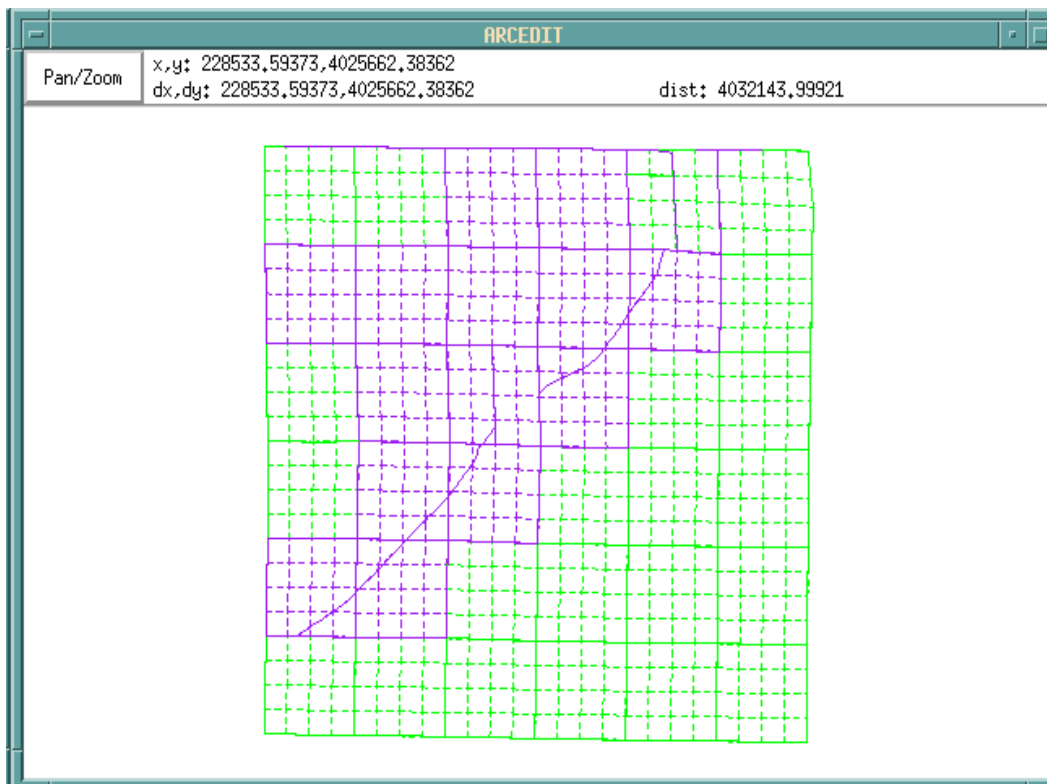
Reliability Lines

The Reliability Lines coverage contains constant-width lines derived from the GCDB input files. Surveyed lines, defined by data from the township.RAW file, are depicted as solid lines. Computed lines, defined by data from the township.LX file, are depicted as dashed lines. The lines are classified according to the Highest Reliability Value (HI_REL_VALUE) which is the highest numeric value of the reliabilities of the endpoints of the lines. For GMM data both the Error Ellipse North and Error Ellipse East are searched. For PCCS, only the Average Reliability of the endpoints is included in the search. Each line is classified as follows.

Highest Reliability Value in Feet	Color
0	Black or White*
1 - 3	Blue
4 - 40	Purple
41 - 200	Green
Over 200	Red

* These lines are black if the background is white. They automatically change to white if the background is black.

The following graphic is a snapshot of a Reliability Lines coverage.

Reliability Areas

The Reliability Areas coverage shows the areas of uncertainty of surveyed lines (in feet). The areas are derived by creating trapezoids around each surveyed line that is recorded in the township.RAW file. The trapezoid is constructed by computing orthogonal offsets at each endpoint, based on the Highest Reliability Value of that point. Then the offsets are connected to construct the areas of uncertainty. The Reliability Areas layer is depicted using the ArcInfo Interface according to a color key similar to the one used for Reliability Lines. However, the areas are filled with a hatch pattern, instead of being solid-colored.

Each area is classified using the following key.
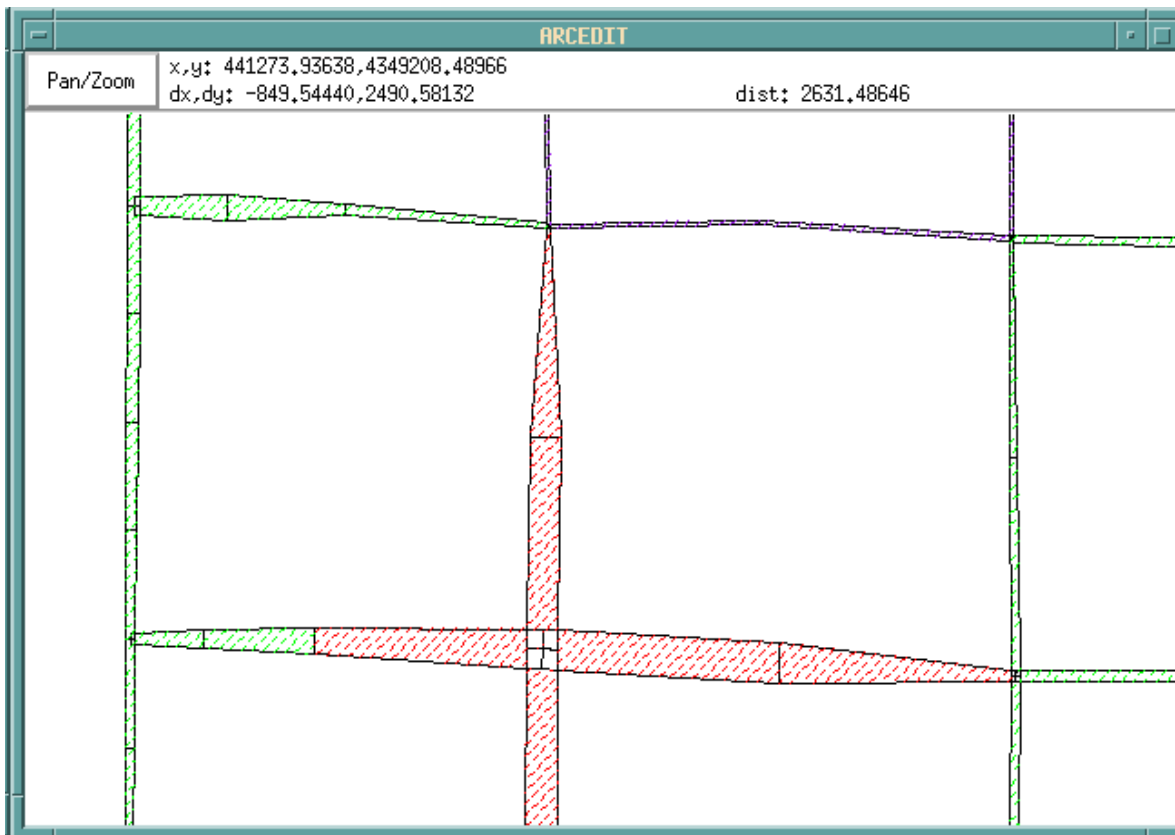
Highest Reliability Value in Feet	Color
1 - 3	Blue Hatching
4 - 40	Purple Hatching
41 - 200	Green Hatching
Over 200	Red Hatching

The following graphic is a snapshot of a Reliability Areas coverage.
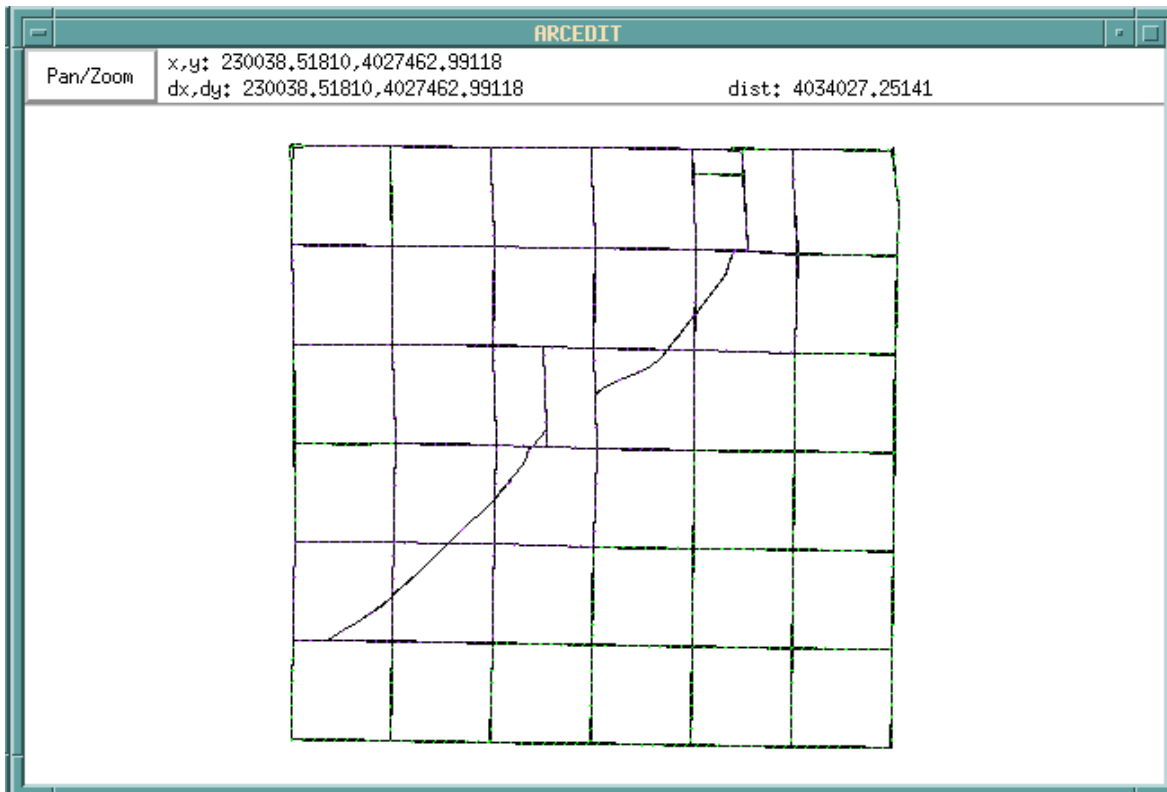
The full value of the Reliability Areas depiction is realized when the user zooms into specific parts of the Reliability Areas coverage. The Pan/Zoom button on the ArcEdit graphic window provides tools to manage the township display.   The Extent tool is used to zoom to specific parts of the township.

The following graphic is a snapshot of a Reliability Areas coverage after the user zooms into part of the township.

The width of the Reliability Area is twice the Highest Reliability Value (Error Ellipse North, Error Ellipse East, or Average Reliability) of the endpoint of the line. This is because the actual position of the coordinate may be up to the given (reliability) distance away from the adjusted location of the point in either direction, perpendicular to the line.

Reliabilities of zero may indicate a fixed (transferred) boundary or lines with endpoints of fixed horizontal control. Coordinates with reliabilities of zero will NOT move as a result of the GMM least squares analysis. Lines that have a reliability of zero at one or both endpoints are not drawn as Reliability Areas. The user is warned about lines with reliabilities of zero if the Reliability Areas coverage is viewed using the ArcInfo Interface.

4

GCDB GIS Coverage Tables

The ArcInfo tables that support the reliability diagrams are provided below. All of the GCDB GIS coverage tables are in the November 2001 GCDB Coverage Format Description Document.

RELIABILITY ARC ATTRIBUTE TABLE (rel_lines_utm.aat)

COL	ITEM NAME	FGDC NAME	WIDTH	OUTPUT	TYPE	N.DEC	A/I	DESCRIPTION
1	FNODE#	-	4	5	B	-	Y	Internal number of the from- node
5	TNODE#	-	4	5	B	-	Y	Internal number of the to-node
9	LPOLY#	-	4	5	B	-	Y	Left polygon number
13	RPOLY#	-	4	5	B	-	Y	Right polygon number
17	LENGTH	-	8	18	F	5	Y	Length of arc
25	REL_LINES_UTM#	-	4	5	B	-	Y	Internal feature ID
29	REL_LINES_UTM-ID	-	4	5	B	-	Y	User feature ID
33	FROM_ERROR_N	FYACC	4	4	I	-	N	From Error Ellipse North in feet (GMM) From Average reliability in feet (PCCS)
37	FROM_ERROR_E	FXACC	4	4	I	-	N	From Error Ellipse East in feet(GMM) From Maximum Reliability in feet (PCCS)
41	TO_ERROR_N	TYACC	4	4	I	-	N	To Error Ellipse North in feet(GMM) To Average Reliability in feet (PCCS)
45	TO_ERROR_E	TXACC	4	4	I	-	N	To Error Ellipse East in feet (GMM). To Maximum Reliability in feet (PCCS)
49	REL_TYPE	-	15	15	C	-	N	Reliability Line Type (surveyed or computed)
64	HI_REL_VALUE	-	4	4	I	-	N	Highest Reliability Value Used for classification by reliability
68	FROM_POINT_ID	-	6	6	C	-	N	Control Point/Station ID
74	TO_POINT_ID	-	6	6	C	-	N	Control Point/Station ID
80	TOWNSHIP	-	16	16	C	-	N	Township Name

The following example shows the GIS data for one GCDB Line.

```
FNODE#               =  0
TNODE#               =  0
LPOLY#               =  0
RPOLY#               =  0
LENGTH               =  1610.49617
REL_LINES_UTM#       =  2
REL_LINES_UTM-ID     =  2
FROM_ERROR_N         =  39
FROM_ERROR_E         =  39
TO_ERROR_N           =  41
TO_ERROR_E           =  41
REL_TYPE             =  surveyed
HI_REL_VALUE         =  41
FROM_POINT_ID        =  100200
TO_POINT_ID          =  100300
TOWNSHIP             =  nm23t0020n0230e
```

RELIABILITY AREAS POLYGON ATTRIBUTE TABLE (rel_areas_utm.pat)

COL	ITEM NAME	FGDC NAME	WIDTH	OUTPUT	TYPE	N.DEC	A/I	DESCRIPTION
1	AREA	-	8	18	F	5	Y	Internal area of feature
9	PERIMETER	-	8	18	F	5	Y	Internal perimeter of feature
17	REL_LINES_UTM#	-	4	5	B	-	Y	Internal feature ID
21	REL_LINES_UTM-ID	-	4	5	B	-	Y	User feature ID
25	FROM_ERROR_N	FYACC	4	4	I	-	N	From Error Ellipse North in feet (GMM). From Average Reliability in feet (PCCS)
29	FROM_ERROR_E	FXACC	4	4	I	-	N	From Error Ellipse East in feet (GMM). From Maximum Reliability in feet (PCCS)
33	TO_ERROR_N	TYACC	4	4	I	-	N	To Error Ellipse North in feet (GMM) To Average Reliability in feet (PCCS)
37	TO_ERROR_E	TXACC	4	4	I	-	N	To Error Ellipse East in feet (GMM). To Maximum Reliability in feet (PCCS)
41	HI_REL_VALUE	-	4	4	I	-	N	Highest Reliability Value Used for classification by reliability
45	FROM_POINT_ID	-	6	6	C	-	N	From Control Point/Station ID
51	TO_POINT_ID	-	6	6	C	-	N	To Control Point/Station ID
57	TOWNSHIP	-	16	16	C	-	N	Township Name

The following example shows GIS data for one GCDB Area.

```
AREA              =  39926.20063
PERIMETER         =  3266.72474
REL_AREAS_UTM#    =  2
REL_AREAS_UTM-ID  =  105
FROM_ERROR_N      =  42
FROM_ERROR_E      =  41
TO_ERROR_N        =  41
TO_ERROR_E        =  41
HI_REL_VALUE      =  42
FROM_POINT_ID     =  700700
TO_POINT_ID       =  600700
TOWNSHIP          =  nm23t0020n0230e
```